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CONTENTS

BIOTECHNOLOGY

BRIEFS

BIOGAS PLANT SAVES OIL--On the occasion of the opening of the agricultural biogas plant in Ismaning near Munich, Federal Minister von Buelow declared that biogas technology could become much more significant in German agriculture. Even though biogas technology provides only a small portion of the primary energy consumption of the FRG, every contribution to decentralized energy procurement and supply must be welcomed. The new biogas plant is a big plant which cannot be compared to plants that were more or less home-made by the hundreds of thousands (East Asia). A considerably better gas yield can be obtained through the further development of the method, good heat insulation, and heat recovery through storage of followup fermentation gas. The plant in Ismaning has a reaction volume of 1,000 m^3 and is thus designed for 1,000 live-weight units of cattle (=1,000 cows). While the daily gas yield in standard biogas plants is 1 m^3 per m^3 of reaction volume, this plant is expected to achieve an efficiency that will be four times higher. The yield would then attain the caloric value of 2,000 lit of heating oil per day. Besides, the farmers can use the rotted liquid manure as odorless, high-grade natural fertilizer on the fields. While the plant in Ismaning is designed as a central plant for the procurement of biogas, in order to meet the energy requirements of one company, another concept is being carried out in Quickborn (rural kreis of Luechow-Dannenberg) with the help of the BMFT [Federal Ministry of Research and Technology]. An interconnected grid of several smaller biogas plants is being erected there. To the extent that the gas is not used on the spot, it is supplied to a central gas storage tank from which other village inhabitants can be supplied with energy. [Text] [Duesseldorf VDI NACHRICHTEN in German 28 Aug 81 p 4] 5058

CSO: 3102/430

ELECTRONICS

BRIEFS

SIEMENS OFFERS BUBBLE MEMORY--For the Siemens modular microcomputer system SMP, which already comprises more than 70 different module cards using the 100 X 160 millimeter "Europaformat," Siemens announces that there is now magnetic bubble storage, also on Europa cards. Magnetic bubble storage is high-reliability, nonvolatile mass storage, which operates without moving parts and so is completely wearfree. The operating temperature range of 0° to 70° Celsius, which is broad compared with traditional means of storage, enables it to be used in harsh environmental conditions. The magnetic bubble storage system can be expanded in stages from a capacity of 128 kilobits to 1 million kilobits. There are extra switches on the control group to safeguard data in the event of a loss of voltage and provisions for error correction. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 8 Sep 81 p 5] 9581

CSO: 3102/414

REPORT DESCRIBES PRESENT STATE OF NUCLEAR DISTRICT HEATING

Frankfurt/Main FERNWAERME INTERNATIONAL in German No 4, 1981 pp 188-193

[Report by the Unichal "Nuclear Energy" Study Committee, presented at the Unichal Congress in Vienna in 1981]

> [Excerpts] The report by the Nuclear Energy Study Commision describes the energy situation, the development, and the current status of nuclear long-distance heat generation in the European countries. It furthermore describes and compares three nuclear heating plant types.

In May 1979, the study commission for nuclear questions on the occasion of the Unichal Congress in Stockholm submitted a report which described the studies and project work done until then on the question of long-distance heat generation in nuclear power plants (1). It presented a comprehensive overview of the on-going planning and basic research in the various Unichal countries.

None of the projects taken up in the report at that time has since then come any closer to practical implementation. The reasons are essentially to be found in the unresolved goal conflicts in the generally prevailing nuclear energy discussion.

Over the past 2 years, oil prices continued to rise drastically and it is to be anticipated that the oil price rise will continue in the future. The growing balance of trade deficits of the oil-importing industrial countries show that it is no longer enough to keep the use of nuclear energy--both for current generation and for long-distance heat supply--open only as an option for the future.

It seems urgently necessary to reduce the consumption of oil and natural gas through the increased use of nuclear energy.

This is also possible in the space heating sector--where the use of heating oil and natural gas predominates in meeting requirements--if long-distance heat supply is further developed and if the possibility of long-distance heat generation with nuclear energy is used.

The report at hand shows the general energy situation and also describes the role of long-distance heat in the European countries. An attempt was then made to describe the current status of nuclear long-distance heat projects in the various countries, so to speak, as a continuation of the last report.

The main point in this year's commission report is a description and comparative consideration of the nuclear heating plants currently undergoing development or ready for offering.

Any consideration on the use of nuclear energy must start with present-day conditions in primary energy utilization. This is why first of all the corresponding statistics for some Western European countries, that is, France, the FRG, Sweden, and Switzerland, were presented. The comparison of the years 1973 and 1979 illustrates the current trend.

It is interesting to note that in the four countries listed, the primary energy consumption, in spite of every effort to save energy, has continued to go up since the first so-called oil crisis in 1973-1974. Primary energy consumption will continue to rise in the future in spite of all attempts to disconnect economic growth from the primary energy consumption--although not to the same extent as in the past. The tie-in factor can be reduced, to be sure, but economic growth today still looks like unrealistic wishful thinking in case of a constant or even a declining primary energy consumption volume.

The use of petroleum of course did not rise any further during the period of time contemplated but in 1979 still covered more than half of the primary energy consumption in each of the four countries. This fact is of grave significance for the raw-material-poor industrial countries because of

The dependence on the oil-exporting countries, especially the OPEC countries and

The extraordinarily heavy burden on the balance of trade which keeps growing due to rising energy prices.

In spite of differing industrialization and motorization degrees, the share of the "household and small-scale consumption" items out of the primary energy consumption of the European countries is between 40 and 50 percent and thus dominant. Because this spread is determined mostly by the heating energy requirements, substitution processes or savings can take effect here in the future. Long-distance heat supply can make an important contribution here.

The description of the scope of long-distance heat supply systems developed so far in the individual countries was prepared in great detail both on the occasion of the IDHC Long-Distance Heat Congress in Fernwaerme and during the World Energy Conference in Munich (2, 3). A comprehensive comparison encounters difficulties because the sources reveal differing presentation methods and reference values.

Available information is given either as a share out of the space heat market, as a share out of the total apartment volume, or as a share out of the number of inhabitants supplied with long-distance heat. It is interesting to note that the development of long-distance heat supply in Denmark, Sweden, and Finland has reached a rather respectable level. In terms of percentages, the FRG is definitely behind the three above-mentioned countries.

An attempt was made--with the help of a comparison of absolute connection figures and heat market shares--to illustrate the conditions here in further detail. The

small long-distance heat supply volume in the FRG here is clearly contrasted against the situation in the Scandinavian countries. We can furthermore tell that the FRG and Sweden meet their heat requirements mostly from thermal power plants while pure heating plant supply systems predominate in Denmark and Finland. In the Eastern European countries, long-distance heat supply on the average is much more highly developed than in the Western European countries.

Considerable differences appear when the connection figure is related to the particular population figures. Even if these specific statistics can be used only for guidance, they do nevertheless clearly show what the differing long-distance heat potential exploration projects in the individual countries look like. In Czechoslovakia, long-distance heat supply accounts for the largest share of the space heat market among all European countries. There, long-distance heat, as in other countries with government-planned economies, has special priority.

The following additional criteria are decisive for the varying conditions of the long-distance heat industry in the individual countries and in addition to climatic and geographic differences:

Energy prices,

Existing built-up area and heating structures,

Electric power industry structures and

Social and general political structures.

Because of the widely differing approaches and conditions in the individual countries with partly government-owned energy industries or planned economies, it would seem that a diverging development, as we compare the countries to each other, will continue also in the near future.

To meet their needs, the Western European countries depend on energy imports to meet much more than half of their energy needs. Only Great Britain and the Netherlands have an opportunity to reduce their dependence--at least for a certain period of time--by means of their own petroleum and natural gas wells (4).

France, Ireland, and Italy must presently import about 80 percent of their primary energy. Belgium, Denmark, and Luxembourg must import between 90 and 99 percent.

The energy imports of those countries consists to a great extent of petroleum. The entire across-the-border worldwide coal trade is presently of minor significance and it seems doubtful whether that will change essentially within the next several years.

Even if oil and gas substitutions, in a short-range and medium-range approach, seem to be of differing significance in the individual countries, the use of nuclear energy for electric current and heat requirement supply would appear to be inevitable for all of them. Nevertheless, the general acceptance of nuclear power plants varies widely in the Western European countries and the other industrial countries.

Industrial development and the maturing of technologies for the peaceful use of nuclear energy were essentially completed already before the first oil price crisis in 1973-74. The expansion plans for nuclear power plants were extensively available and large-scale industrial utilization became worldwide during the sixties. At that time, nuclear power plant planning efforts were tackled quite efficiently; they were further pursued and in some places there were even crash programs.

Here we must mention above all France which, with a need for importing more than 80 percent of its energy requirements, was able to figure out how heavily the resultant difficulties would burden its national economy in the future. In an unparalleled national power effort, France began to carry out its nuclear power plant plans which had been revised upward. France began to build nuclear power plants on the assembly line. At this time, a new power plant is being placed in operation in France roughly every 3 months. The goal is to put 51 nuclear power plants with 53,000 Mw in the grid by the year 1988. By that time, 70 percent of the current will come from nuclear power plants. During the first half of 1980, the figure was already 22 percent. This will clearly reduce the country's present-day dependence on oil and its burden on its foreign-exchange situation.

Switzerland decided on nuclear energy a long time ago because, except for water power, it has no other domestic energy sources. Although it is rather difficult in Switzerland to carry out large-scale technological projects because of the particularly strongly developed democratic rules of the game, nuclear power plants in that country already generate 30 percent of the electric current.

Austria--heavily dependent on energy imports like Switzerland--likewise prepared for the use of nuclear energy. In November 1978, Austria's citizens with a slim majority during a plebiscite voted against commissioning the Zwentendorf Nuclear Power Plant. After that, parliament passed a law banning the use of atomic energy.

Belgium has been using nuclear energy for many years. About one-fifth of the current comes from nuclear power plants. None of the Belgian parties so far have come out fundamentally against the use of nuclear energy.

England--the European country with the longest experience in the peaceful uses of nculear energy and presently relieved of its momentary energy worries by the petroleum and natural gas discoveries in the North Sea--nevertheless has decided to continue the development of nuclear energy. Starting in 1982, the construction of a new nuclear power plant is to be started every year.

At this time, nuclear energy contributes 12 percent to electric power generation in England. By the middle of the eighties, this share will go up to 20 percent.

Sweden is an example of the way in which excessive politization of the nuclear energy topic can almost wipe out the fruits of decades of systematic development efforts. In a referendum, the Swedish population decided in favor of the further utilization of existing nuclear power plants and the completion of those already under construction after the government and parliament--similar to what happened in Austria--found themselves unable to act in policy terms in keeping with their mandate.

Spain--whose economy likewise is hard hit by the burdens of large oil imports--presently has two nuclear power plants in operation which contribute 6 percent to power generation. Another six plants are to become operational over the next several years and by 1985 they are supposed to supply already 11 percent of the current from nuclear energy. By 1990, a total of 16 nuclear power plants are to be included in the grid, corresponding to a share of about 40 percent of the total current supply.

In the USSR, as in all countries of the East Bloc, the development of nuclear energy is being pursued in a goal-oriented manner. At this time, about 14,000 Mw of nuclear power plant capacity are in operation and about 25,000 Mw are under construction or on the drawing boards.

The political accemptance of nuclear energy in the FRG extends from unrestricted "yes" via so-called residual requirement supply all the way to absolute rejection. Early in 1981, 10 nulcear power plants provided current for the public grid in the FRG. At this time, 11 nuclear power plants are under construction and another 13 reactors--whose reaction however is far off in the future--have been planned. The current nuclear energy share out of the total current requirement supply comes to about 12 percent. Forecasts regarding specific further expansion efforts are difficult to make because of the prevailing uncertainty in terms of the legal situation involved in the licensing procedures and the partly lacking political decision-making readiness. Nuclear power plant opponents propose the construction of fossil thermal power plants to meet the rising need for power plants. On the other hand, positions have been adopted repeatedly especially in recent times to the effect that the thermal power plant industry cannot be used as an alibi by nuclear power plant opponents.

In the United States, 74 nuclear power plant blocks had an operating license at the end of 1980; 37 blocks had a construction license and another 19 nuclear power plants had been ordered. At this time, the current share from nuclear power plants is about 11 percent and by 1990 the figure is to be 22 percent.

Today Japan is still ahead of France, the USSR, and all other countries and in second place worldwide after the United States when it comes to the use of nuclear energy. The realization of import dependence did not allow a massive protest movement to arise although there are of course opponents of nuclear energy in Japan likewise. At this time, 22 nuclear power plants are already in operation in that country and another 13 are under construction. The share of about 13 percent out of the current generation volume is to be roughly doubled by 1985 and quintupled by 1995.

At the present time, 233 nuclear power plants with about 130,000 Mw are in operation and another 250 with 325,000 Mw are on order in 35 countries.

Considerations concerning the use of nuclear energy for long-distance heating purposes have been entertained in Western and Eastern Europe for quite some time. They were compiled specifically for each country.

Sweden

Sweden in 1956 decided to erect the Agesta Nuclear Thermal Plant near Stockholm in a cavern in the rock. In July 1963, this first thermal power plant, based on nuclear energy, was placed in operation (5).

The thermal output for long-distance heat supply came to 55 Mw and the electrical output was 10 Mw. The plant was a PWR with heavy water as moderator and coolant which made it possible to use natural uranium. The plant was essentially made by Asea and AB Atomenergie. The reactor was closed down for purely economic reasons in 1974.

The Scandinavian countries, Sweden and Finland, for the most part, continued to push the idea of using nuclear energy for long-distance heat (6, 7). In 1967-1970, a long-distance heat supply plan was developed for Stockholm which called for three big nuclear thermal power plants to supply a large long-distance heat network covering the entire urban area. In this connection, the current supply enterprise in Stockholm submitted a request for licensing a thermal power plant running on the basis of a LWR in 1968. The maximum electric output was to be 850 Mw during condensation operations and the maximum long-distance output was to be 1,200 Mw with a pure turbine output counterpressure of 420 Mw in that case. The plant was supposed to be built in Stockholm. It was to be erected as an underground thermal power plant whereby the reactor was to be housed in a rock cavern while the turbine and the auxiliary systems were to be placed in a second separate cavern. It had been planned to install the facility 20-30 m below the surface in the rock, in other words, 10-20 m below sea level. The Swedish reactor safety commission was unable at the end of the sixties to issue a license for the site in the city and the government established a special commission with the job of settling the question as to a nuclear thermal power plant near the city within 2 years. Because of the nuclear controversy, all considerations regarding the construction of new nuclear power plants have been shelved in Sweden for the time being.

Some of the more recent planning efforts in Sweden start with the idea of taking long-distance heat for Sweden from the Forsmark Nuclear Power Plant which is about 120 km from Stockholm. In this connection it would be possible, in addition to the Stockholm metropolitan area, also to supply Uppsala from this system. A heat output of about 2,000 Mw is to be transported over that distance with a maximum lead-in temperature of 165°C.

Similar studies are being pursued to supply Malmö from the Barsebäck Nuclear Power Plant which is about 26 km away. In this way it would also be possible to supply Lund via an approximately 4-km branch line.

Finland

Investigations are also being conducted in Finland to supply the capital with long-distance heat from nuclear energy. A report by the Energy Supply Commission in Helsinki dating back to 1973 notes that supply with electricity and long-distance heat from nuclear energy represents a definitely better solution than the other energy supply alternatives.

A region 40 km west of Helsinki was considered a realistic place for such a plant. A study group established in 1975 was to clear up the technical and economic conditions (8). It has been planned to take a heat output of 1,000 Mw from a nuclear power plant and to transport it over a 40-km transport line with a temperature spread of 160/60°C to Helsinki. The practical implementation of this project however is presently still up in the air.

FRG

The first major studies in the nuclear thermal power sector were started by industry in the FRG with its climatic conditions which are not as good for long-distance heat when compared to the Scandinavian countries. BASF [Baden Aniline and Soda Factory] in Ludwigshafen planned the construction--during the second half of the sixties--of two nuclear power plants on a light-water base with the tapping of process steam (9, 10). Plans called for a system with two PWR with a thermal output of 2,000 Mw which in each case, in addition to an electrical output of 447 Mw, were also supposed to turn out 1,000 t/hr of steam with 18 bar and 265°C. This steam was needed for the production facilities of the chemical plant.

The fundamental planning criteria were as follows:

Double-block design for reliable supply of needed steam output,

Erection of the plant on the terrain of BASF in Ludwigshafen with the idea of having short transportation distances for energy and

Clear separation of nuclear and conventional plants.

Construction was supposed to be started on the plant in 1971 and it was to be commissioned in 1975.

Because of the nuclear energy controversary which developed in the FRG during that time, the authorities first of all demanded explosion protection and later on, in addition, underground construction, and finally construction outside the metropolitan population area. This meant that the enterprise found it practically impossible to build the plant.

Comprehensive investigations for the use of nuclear energy in the sector of long-distance heat supply likewise were carried out during the middle of the seventies in the context of the overall study on long-distance heat as well as the four long-distance heat plan studies which had been worked out for certain regions (11, 12, 13, 14, 15). It turned out that the use of nuclear energy for long-distance heat is not so much a technical but rather above all an economic problem because the tapping of long-distance heat from the nuclear power plants which were planned or built for current generation was and is possible without any special difficulties.

Details on that were reported already in Stockholm. The pertinent literature was compiled in this year's report, specifically, for all of the countries mentioned here.

Switzerland

Switzerland likewise since the middle of the seventies has been looking into the idea of taking heat from nuclear power plants (16). The projects investigated involved the nuclear power plants at Muehleberg, Kaiseraugst, and Beznau and the regions of Bern, Basel, as well as the Aare/Limmattal Region. The projects mentioned however cannot presently be carried out because of the nuclear controversy which also prevails in Switzerland but primarily because there are no developed long-distance heat population areas and thus no considerations regarding economical operations. On the other hand, the supply of a cardboard factory with steam from the Goesgen power plant via an only 2-km pipeline was started in 1979.

France

France has for quite some time been involved in special considerations regarding the construction and use of small nuclear power plants called Thermos which produce heat only for heating purposes without any power-heat tie-in.

A demonstration plant of the Thermos Reactor with a thermal output of 100 Mw is to be erected on the land of the Grenoble Nuclear Studies Center. It is hoped that 20 reactors of this type can be erected in smaller cities in France by the end of this century. This project will be covered in detail in this report.

What conclusions should we now draw from this general situation?

The fuel situation for present-day long-distance heat generation plants in Europe is characterized by the use of fossil fuel. Here we must of course register considerable differences from one region to the next. In France, for example, they use mostly oil for long-distance heat generating plants. In the Netherlands on the other hand they use natural gas whereas in the FRG plants in the power-heat tie-in system are frequently operated with coal whereas thermal plants are mostly operated with oil or natural gas. This situation will hardly change within the next ten years.

Heating oil and natural gas today dominate as fuels in the heat generation sector; together, they account for a share of about 80 percent out of the space heating market in the FRG. The increased use of long-distance heat supply offers the possibility of reducing the consumption of heating oil and gas in this field and in the future to meet the space heating requirements also with nuclear energy.

Although long-term domestic fossil energy sources are available in the USSR, that country nevertheless does have the problem of transporting coal, oil, and natural gas over long distances--something which is a burden on the economic side of energy procurement.

In the Western part of Europe on the other hand--in view of the rising shortage of fossil energy sources, especially oil and later on also natural gas--there arises a need for using the remaining domestic coal and imported coal as raw material for the chemical industry. Because of this task and because of the further goal of generating synthetic natural gas, the coal quantities available for heat generation are considerably reduced. The only way out thus in long-range terms is

nuclear energy. This is why, to meet the space heating requirement, steps will have to be taken toward the utilization of nuclear energy in the not too distant future also in Western Europe.

The introduction of nuclear power plants to relieve the fossil energy market here faces some obstacles.

So far it has not been possible to achieve full acceptance of nuclear energy in all Western European countries. The economy of long-distance heat from nuclear power plants is difficult to implement in Western Europe already because here, due to climatic conditions, the utilization time during the maximum heat load is only 2,500-3,000 hours per year (Eastern Europe 3,500-4,000 hours). This is why it will be necessary to use nuclear energy only for the basic load, that is to say, to meet only about half of the required maximum heat output and thus most of the heat volumes with the help of nuclear energy out of the large total connection potentials.

Because of the hitherto practiced safety velocity, nuclear power plants--which can be converted into nuclear power plants through rebuilding or minor changes--are too far away from the major population concentrations which at the same time represent the big long-distance heat potentials. This results in extraordinarily high investments for the necessary transport line for long-distance heat in the case of such projects and those investments so far have seriously threatened the economy or at least the financiability. As fossil fuel prices keep rising, heat transport over long distances will also become economically justifiable to the extent that the corresponding population concentration areas with a high thermal potential have already been opened up in a decentralized fashion in terms of long-distance heat supply.

Regardless of that it will be necessary to erect thermal plants operated with nuclear energy which, because of their small threat potential, can also be built in the immediate vicinity of cities or even in the cities themselves. This will become necessary especially where small cities are to be supplied with long-distance heat but are to be independent of fossil energy sources.

The accent in this report was placed on the technical description of three thermal power plant reactor types, that is, Thermos in France, Secure as the joint Swedish-Finnish development and the AST-500 in the USSR (24, 25, 26, 27, 28).

For a detailed description of these projects, we would like to refer to the report itself. At this point we will only indicate the major differences among the three concepts.

1. Heat Output and Lead-In Temperature

The design output of the reactors was influenced by the development status of the long-distance heat networks in the individual countries and by the long-term goals in national long-distance heat development. Moreover, market studies were conducted as to the possibility of using nuclear power plants in population concentrations that would be suitable for long-distance heat supply in an effort to select the design output.

The determination of the temperatures at the outlet of the nuclear power plant depended on the lead-in temperatures of the connected long-distance heat network. These lead-in temperatures were determined at the start of the network buildup and they may vary from one network to the next.

2. Core Cooling

In the case of Thermos and Secure, the core is cooled during standard operations through a forced circuit whereas in the case of the AST-500 it has a natural circuit [cycle]. The core cooling especially in the case of Thermos essentially corresponds to a system used in the big PWR.

3. Output Regulation and Emergency Shutoff

In the case of Secure, the output is regulated through a change in the reactivity of the moderator by supplying boric acid for fresh water. Boron-water is feed into the primary cooling cycle for the reactor's emergency shutdown. The reactor's long-term shutdown is accomplished through boron-containing steel balls which are introduced into the core.

The output at Thermos is regulated in the case of the big PWR by running the absorber rods in; their drives are arranged below the reactor pressure vessel. The regulator drives [motors] are supplied with power from a redundant power grid. The emergency shutdown can be accomplished both automatically by inserting the regulating or safety rods or also manually. In the case of the manually-controlled emergency shutdown, a neutron poison is fed into the reactor basin and into the primary cooling cycle.

The output regulation at the AST-500 is accomplished by changing the mass current [slow] in the medium cycle. This produces a change in the steam portion in the primary cooling cycle and thus a change in the reactivity of the moderator. For emergency shutdown, absorber rods are inserted into the core from the top. Compared to the design in the case of the Thermos, this does not require any connecting charges in the flooded area of the reactor vessel.

4. Safety Concepts

The average fuel output is important in reactor safety because it determines the danger of the release of waste products. It has turned out that the AST-500, with 10 kw/kg of uranium, has the least average fuel output. The corresponding figure for Thermos is 32 kw/kg of uranium, in other words, more than three times as much. The average fuel output of Secure is 15 kw/kg of uranium and thus is more than that of the AST-500 but definitely less than that of Thermos.

The separation of the primary cooling cycle from the basin by means of gas bubbles is a special feature of Secure. This system represents a safer device for fast reactor shutdown. The functional effectiveness of this system among other things was proven in a demonstration model. The extent to which the results of the theoretical investigations and experiments can be transposed to a big plant cannot be judged.

The entire primary cooling cycle, including the heat exchanger for the intermediate cycle, is integrated into the reactor pressure vessel in the case of the AST-500 and Thermos. Compared to the Secure design--where the revolution pumps of the primary cooling cycle and the heat exchangers to the intermediate cycle were placed outside the safety enclosure--the integrated arrangement for Thermos and AST-500 represents a safe barrier.

On the basis of available information it is impossible to make any statements regarding differences in the release of radioactivity both during normal operation and in case of assumed trouble.

5. Plant Investments

The documentation available to the commission also contained initial data on plant investments. The manufacturers had submitted specific offers for Thermos. These amounts thus represent a realistic figure at this point in time (29).

On the other hand, one must consider the data for Secure as a very recent estimate without any consideration of the requirements connected with a specific site.

No prices based on cost are available for plant investments connected with an AST-500 (30).

Without considering these reservations, the comparison shows that thermos reveals the highest specific investment for Grenoble. On the one hand, this is a consequence of the degree of implementation of the project whereas on the other hand the cost decline begins to make itself felt already in connection with output figures between 100 and 500 Mw.

We cannot say to what extent other parameters influenced the investments without a detailed breakdown of the investment amounts in accordance with the individual structural components.

By way of summary one can judge the three concepts as follows:

In the Thermos and AST-500 systems, feasible concepts were implemented on a short-term basis. Both reactor types reveal essential characteristics of the reactors which are operated commercially in France and the Soviet Union. On the other hand, simple, new systems were deliberately developed for many important components in the case of Secure.

Otherwise, the three plant concepts--using the basin reactor, the "cold core," and the three cooling cycles--represent the practical expression of the safety requirements which are necessarily high when such plants are placed near cities.

In conclusion we can say, regarding the significance of the heat reactors for future long-distance heat generation, that prices for fossil primary energy will in the future presumably continue to rise more than prices for capital goods. There will be an increasing demand for replacing primary energy with capital. Central long-distance heat supply, using the power-heat tie-in, will make it possible to materialize this requirement for the space heating sector. The economic advantages of

nuclear long-distance heat generation should be used in the future for the supply of long-distance heat at reasonable cost.

These advantages consist in the following:

Lower heat production costs coupled with a greater output from the generating plant. This is a consequence of the cost decline which is particularly effective in connection with nuclear plants. The reason for this is to be found in the large share of fixed costs and the lower share of fuel costs compared to fossil-fired thermal power plants;

Greater independence of the long-term development of energy prices. First of all, the small share of fuel costs has a positive effect on the heat production costs. Besides, it is advantageous that one uranium charge will suffice for a period of several years.

When taking long-distance heat from large power plants, the main problems are heavy investments for transport lines as well as the absence of extensive long-distance heat networks with sufficiently large connecting output figures. This is why the following requirements above all apply to economically justifiable nuclear long-distance heat generation at this time:

Placement of production plants near the city,

Generation of basic load and

High degree of safety during all operating states.

The reactors described represent a justifiable concept for meeting these requirements.

Nuclear thermal plant manufacturers should standardize such systems so that the licensing procedure for the erection of structurally identical plants can be simplified.

The heat output should practicably be so dimensioned that nuclear thermal plants can meet the basic load requirements. But the advantages of the cost decline should not be disregarded here.

Differing optimum heat output figures will results from these requirements for nuclear thermal plants in the individual countries.

In order to facilitate the production of adequately large numbers, it will be necessary to expand the long-distance heat networks briskly so that they will reach the required connection output figures.

Close cooperation will be necessary in the future between long-distance heat operators, the reactor makers, and policymakers to coordinate these developments.

It is the task of the policymakers to create the general conditions for the rapid development of long-distance heat systems. Because of the heavy financial advance

payments, it will be necessary to work out possibilities of reducing the start-up losses and accordingly it will be necessary to include funds in the planning of the budgets for these projects. The positive contributions from comprehensive investments in the long-distance heat sector to the employment situation must also be considered here.

Because of the great advantages to the national economy deriving from the use of nuclear thermal plants in the space heating sector, such as the reduction of the foreign-exchange outflow for the import of primary energy, improved utilization of capacities in the nuclear industry, as well as safety regarding fuel supply in the long-distance heat sector, policymakers are called upon to arouse an understanding for the necessary use of nuclear energy, for example, in thermal reactors among the population.

Regarding the issue of site designation, the policymakers must also consider the positive effects of nuclear energy utilization especially regarding an immission situation in population concentration areas which today are heavily polluted.

The Grenoble demonstration project will be trend-setting for further development of long-distance heat generation by means of thermonuclear power plants.

BIBLIOGRAPHY

1. Report of the Unichal Study Commission on Nuclear Questions: Long-Distance Heat from Nuclear Power Plants, May 1979.

2. Development of district heating supply and distribution systems. IV International district heating conference, Sirmione, May 1980.

3. Energy supply, Volume 1 B. 11th World Energy conference, Munich, Sept. 1980.

4. Barthelt, K., "Is Energy Supply Secured after 1985?" VIK-Mitteilungen 1, 1981.

5. Lilliehöök, B., Tuxen-Meyer, H., "The Agesta Atomic-Energy-Powered Thermal Power Plant," ERA, No 9, Vol 36, 1963, Organ for the Society for Efficient Electricity Use.

6. Nuclear Energy for Combined Production of Power and Heating Water for Long-Distance Heat, Stockholm Electric Power Plant, 1971.

7. Margen, P., "Considerations on the Economy of Long-Distance Transmission, Storage, and Distribution of Heat from Nuclear Plants with Existing and New Techniques," STUDSVIK, 1977.

8. Kaarlonen, K., Thermonuclear Power Plant Project in the Capital Region, 1976.

9. "Nuclear Power Plant with Process Steam Generation," brochure by BASF-Ludwigshafen, Project BASF, 1971.

10. Nagel, O., "The Significance of Low-Temperature Process Heat from Nuclear Plants for Energy Supply of Chemical Planta," report to the information conference of the Commission of European Communities on Industrial and Technological Aspects of the Generation of Nuclear Heat by Means of Light-Water-Cooled Reactors, Brussels, 7 December 1976.

11. General Study on Possibilities of Long-Distance Heat Supply from Thermal Power Plants in FRG, Federal Ministry of Research and Technology, Bonn, 1977.

12. Berlin Plan Study, Federal Ministry of Research and Technology, Research Order ET-5076 E, Bonn, 1976.

13. Koblenz/Bonn/Cologne Plan Study, Federal Ministry of Research and Technology, Research Order ET-5075 E, Bonn.

14. Mannheim/Ludwigshafen/Heidelberg Plan Study, Federal Ministry of Research and Technology, Research Order ET-5073 E, Bonn, 1976.

15. Oberhausen/Western Ruhr Region Plan Study, Federal Ministry of Research and Technology, Research Order ET-5074 E, Bonn, 1976.

16. Mayor, I. D., "Heat from Nuclear Energy, Project in Switzerland," report delivered to the 12th Power Plant Engineering Conference of the Dresden Technical University, 25-26 November 1980.

17. "Utilization of Atomic Energy in the Regions of the Far North," excerpts from "Atomic Industry and Technology in the USSR," Moscow, Atomic Publishing House, 1977.

18. Khrilyev, "Selection of Optimum Parameters for Heat Sources for Heat Transfer from Thermonuclear Power Plants," report delivered to the 12th Power Plant Engineering Conference of the Dresden Technical University, 25-26 November 1980.

19. "SMall-Scale Thermal Plant Prototype in Operation," ATOMWIRTSCHAFT, 2, 1979.

20. "600-Mw Vast Breeder Demonstration Power Plant in the USSR in Operation," BRENNSTOFF-WAERME-KRAFT, 10, 1980.

21. "Prospects of Steam Turbine Construction in the USSR," VGB KRAFTWERKSTECHNIK, 8, 1980.

22. Vlach, J., "Long-Distance Heat Supply from Nuclear Energy Sources in the USSR," report to the 12th Power Plant Engineering Conference of the Dresden Technical University, 25-26 November 1980.

23. Mueller, R., et al., "Consideration of Safety-Engineering, Functional Construction and Design Aspects in Planning and Drafting Thermonuclear Power Plants," report delivered to the 12th Power Plant Engineering Conference of the Dresden Technical University, 25-26 November 1980.

24. Michel, J. C., Marinot, G., "The Thermos Project—A French Application," November 25, 1980.

25. "Thermos--Explanatory Notes," French Atomic Energy Commission, June 1980.

26. Nilson, L., Hannus, M., Secure nuclear district heating plant. Papers of the meeting in Otaniemi, Finland, 21-24 August 1977.

27. Tokarev, Yu., et al, Boiling water reactor in prestressed reinforced concrete vessel for atomic central heating-and-power plant. Papers of the meeting in Otaniemi, Finland, 21-24 August 1977.

28. Skvortsov, S. A., et al, The low-temperature water-water reactor for the district heating atomic power plant. Papers of the meeting in Otaniemi, Finland, 21-24 August 1977.

29. "Heat-Generating Thermos Reactor," French Atomic Energy Commission, Program Department, January 13, 1980.

30. Menon, S. et al: Rysk-Svenskt Seminarium angaedne värme reaktorer. Studsvik Report KZ-80/256.

5058
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POTENTIAL FOR USE OF REGENERATIVE ENERGIES IN FRG

Frankfurt/Main ELEKTRIZITAETSWIRTSCHAFT in German 25 May 81 pp 378-381

[Article by Graduate Engineer Joachim Nitschke, staff employee at the Association of German Electricity Works, e.V. (VDEW), Frankfurt (Main), and Dr of Engineering W. Piller, staff employee at the Isar Amperwerke AG, Munich: "Thoughts on the Use of Regenerative Energy Sources and Numerical Values on Their Possible Future Share in the Primary Energy Demand in the FRG"]

[Text] It is a legitimate desire to want to use regenerative energy sources for meeting our energy needs instead of limited raw materials, even if in some cases these are sufficient to last hundreds of years. On the basis of the literature, the authors present the theoretical potentials of the various regenerative energy sources for the world and the FRG. The secondary energies which can be generated with them, the technical problems of their utilization, as well as the environmental questions which arise are compiled and presented in a table. An optimistic assessment points to the possibility that in the year 2000 some 8 to 9 percent of the FRG's primary energy demand may be met by regenerative energy sources.

The complex of questions involved in the expression "energy supply" is in the limelight worldwide as one of the greatest problems of our times.

Of course, this applies especially to a country as highly industrialized as the FRG is, whose "to be or not to be" in the world market as well as its private-sector standard of living at home, among other things, is closely connected to an adequate and assured supply of energy. Thus it is not surprising that in addition to the experts, who have been occupied for a long time with this body of subjects, by now broad circles of the general population have also begun to concern themselves with questions of energy supply. This awakening energy awareness, which is absolutely essential and should even be encouraged further, is a positive feature--but with a portion of the population it is overshadowed by strongly emotional views in the absence of adequate factual knowledge and by reason of one-sided information.

Meanwhile this field, which from the nature of the subject is very complex and difficult, is all too frequently simplified unduly. Especially in connection

with catchphrases such as "soft technology," untenable patent remedies based on regenerative energy sources are frequently offered. Not seldom this goes hand in hand with a condemnation of the technology being practiced--something which is not helpful in the examination of the burning questions of energy supply, but rather is only detrimental to this and, moreover, often adds an emotional charge in advance to suitable solutions and concepts.

Certainly the present article cannot provide a solution for this state of affairs, but we hope that it may help to objectify the discussion and put it on the basis of largely certain facts. Table 1 shows briefly to what extent the regenerative energy sources--which again and again are the rallying points for a group of "energy debaters," who unfortunately are strongly polarized today--could contribute to the FRG's primary energy supply in the year 2000.

In this area it is less a matter of absolutely precise numerical data--nobody is able to provide that--than it is a question of the order of magnitude of such contributions.

From the wealth of proposals in the literature concerning regenerative energy sources and their possibilities for utilization (1 to 16), Table 1 sifts out a short extract which gives a general idea of the potentials and possibilities for using regenerative energy sources in the FRG. At the same time the table contains those quantities and facts each mentioned repeatedly by several authors--gleaned from an overall survey of the literature, which is often contradictory.

In a largely self-explanatory way, Table 1 shows the respective regenerative energy source in column 1, in column 2 presents the theoretical energy potentials, subdivided into values for the world and the FRG, then in the following columns gives an indication of the average power densities to be expected and continues with the data on the secondary energy which is to be generated and an indication of the type of system in each case which is needed for energy conversion. Finally, following some remarks on technical problems and cost estimates according to the present state of the art with regard to the conceivable developmental potential, as well as the complex of environmental questions from the viewpoint of the FRG, the survey is rounded out by an indication of feasible prospects of application as well as the absolute contributions to be expected of the individual regenerative energy sources, in TWh/a [terrawatt-hours/year], for the meeting of our energy needs for the year 2000.

Moreover, from this last column one can derive an overall potential from regenerative energy sources of 352 TWh/a in the year 2000 for the FRG. If one sets this sum at 100 percent and considers the individual contributions by the various regenerative energy sources, he finds that the biggest contribution, of 210 TWh/a, is expected from the sector of environmental heat. In second place, with a share of about 85 TWh/a, equivalent to 24 percent, is the potential from water power, with inland waters being especially important here.

It should be noted further that of the technically utilizable potential of water power, today already more than 60 percent is being used in running-water

and stored-water power plants, which clearly refutes, by the way, the widely current impression that using regenerative energy sources is a discovery of our own days. Rather it is no doubt the case that every energy source for which appropriate technical systems and equipment for energy conversion had been developed and were available has always been and is being used with due regard to the costs connected with its utilization.

Finally, solar radiation is able to furnish an estimated contribution of 33 TWh/a (≙ 9 percent), and on the basis of the above-mentioned assessment we get a maximum of 24 TWh/a for wind energy, corresponding to 7 percent of the total expected energy supply from regenerative energy sources in the year 2000. The other regenerative energy sources described in Table 1 can scarcely make any noteworthy contributions from what we can see today--and in this connection, within the remaining 19 years of our century it is highly certain that no revolutionary innovations can be expected.

When the primary energy demand for the year 2000 in the FRG, which is estimated at 4,150 TWh/a [16], is given the value of 100 percent, the sum of the maximum estimated values from regenerative energy sources is equivalent to a share of 8 to 9 percent.

This percentage, which is based on predictive data arrived at through definitely optimistic assumptions, makes an unequivocal statement about the expectations which can be placed in the potential from regenerative energy sources. Moreover, it makes plain that even the discrepancies in the absolute contributions made by individual regenerative energy sources as found in the values indicated by the various authors--discrepancies which a study of the literature data shows to be quite large in some cases--cannot change decisively the picture with respect to the order of magnitude of the contribution to the expected primary energy demand.

The relatively small contribution of regenerative energies to meeting the primary energy demand should not lead us to neglect developments on the utilization of these energy sources. Even small amounts reduce the additional demand for non-renewable primary energies--especially in the developing countries. But the figures show that the expansion of conventional energy structures, including nuclear power, must not be neglected under any circumstances.

To pursue the line of thought further on this score, let us just consider by way of example the largely still unutilized potential of environmental heat--which is probably still the most promising regenerative energy source for the FRG. The heat pump is of decisive importance for its utilization. But the heat pump needs additional energy for its driving mechanism. According to the present state of the art, this can be supplied in the form of oil, gas, or electricity. But because of the absolute maxim that other sources must be substituted for oil, this fuel is likely to be largely out of the picture.

Thus we are left with gas and electricity. Here, according to the present state of the art gas is important mainly for systems with large heat pumps, whereas the major portion of utilizable environmental heat in the domain of supplying space heating to the household [16] is likely to have a need for small electrically operated heat pumps. Since only in the rarest of cases will these systems be

likely to replace heating plants which run on electricity as a secondary energy source, but probably for the most part will be substitutes for existing oil-fired plants, and moreover since in the future as well there will continue to be a demand for new heating plants, for this field of application alone one can expect an additional demand for electricity. Moreover, in our present line of thought let us not even go into the hotly debated question of output--whether or not in the future substantially increased power-plant capacity will be necessary--but let us merely state that "work" in the form of electric energy must be made available as cheaply as possible.

This is true in any case if one wants to achieve the ambitious goals of exploiting the potentials from regenerative energy sources in accordance with the last column of Table 1. Thus there can be no conflict and no competition between on the one hand regenerative energy sources together with their relevant technologies, and on the other such technologies for the transformation of fossil and nuclear raw materials, but only a close and sensible "cooperation-mutual support."

Although in our considerations up to now we have not touched at all on questions such as "capital substituting for energy"--certainly a serious economic and business-management problem--or on the great range of technical tasks of development and improvement still to be clarified and performed in connection with devices for the utilization of regenerative energy sources--let us at least draw attention to one point more. Not only the development for mass production of devices for utilizing regenerative energy sources, but also the requisite expansion and redesigning of conventional energy-generating and distributing facilities requires considerable periods of time. Therefore, if we want to achieve the goals aspired to in reducing our dependence on imports in the energy sector, a clear stand should be taken on all technologies necessary for these goals, and among these are also the technologies of the energy transformation of fossil and nuclear-energy raw materials--so that we do not have to come to the realization later that we have run out of time.

BIBLIOGRAPHY

1. BMFT-AGF/ASA [Federal Ministry for Research and Technology-Working Group of Large Research Institutes/Applied Systems Analysis], "Energiequellen fuer morgen?" [Energy Sources for the Future?]; Part 1: Future Energy Demand Calculation and the Significance of Non-fossil and Non-nuclear Primary Energy Sources; Part II: Utilization of Solar-radiation Energy; Part III: Utilization of Wind Energy; Part IV: Utilization of Sea Energies; Part V: Utilization of Geothermal Energy; Part VI: Utilization of Water Energies. Abridged version: Publisher, Hans Matthoefer: Non-nuclear and non-fossil Primary Energy Sources. All volumes in Umschau Verlag, Frankfurt (Main), 1976.

2. Kertz, W., "Can the Earth's Heat Meet Our Energy Needs?," UMSCHAU 72 (1974), pp 661-668.

3. Wilson, E. M., "Energy from the sea-tidal power," UNDERWATER JOURNAL, August 1973, pp 175-186.

4. Fuchs, H., "Utilization of Water Power in the FRG--Its Development and Significance," ELEKTRIZITAETSWIRTSCHAFT 66 (1967), pp 292-297.

5. Steinmetz (publisher), "Employment of Heat Pumps in Heating Engineering," lecture and discussion meeting at the HdT [Haus der Technik], Essen, 29/30 June 1976.

6. Grallert, H., "Solarthermische Heizungssysteme" [Solar-thermal Heating Systems], Oldenburg Verlag, Munich, 1977.

7. Dietrich, G., "Possibilities of and Limits to the Use of Solar Energy for Space Heating in the FRG," KFA-STE-IB-2/75, August, 1975.

8. Stoy, B., "Wunschenergie Sonne" [The Dream Energy of the Sun], Energieverlag, Heidelberg, 1977.

9. Meliss, M.; Paul, J.; Steimle, F., "Utilizable Energy Fluxes," paper read at the congress "Changes in Energy Demand and Possibilities for Meeting this Demand," Berlin, 5 to 7 December, 1977.

10. Jensch, K; Schaefer, H., "Potentiale und Nutzung staendig verfuegbarer Energiequellen" [Potentials and Utilization of Permanently Available Energy Sources], Number 1 of the series by the chair and laboratory for energy economics and power-plant engineering of the Munich Technical University, Technischer Verlag Resch KG, Graefelfing, 1980.

11. Penczynski, P., "Welche Energiestrategie koennen wir waehlen?" [Which Energy Strategy Can We Choose?], Siemens AG, 1978.

12. Data from MAN [Augsburg-Nuernberg Machine Factory, Inc.], Munich, 1980.

13. Meliss, M., "On the Significance of Regenerative Energy Sources for the Future Energy Supply of the FRG," ETZ-A, Volume 99, No 7, 1978.

14. Schafer, H., "Kernfragen" [Key Questions], Econ Verlag, 1978.

15. VDEW, "The Economic Significance of Electric Energy on the Heating Market," Association of German Electricity Works, e. V., Frankfurt (Main), 1980.

16. "World Energy Outlook," Exxon Corporation, December, 1980.

Table 1. Regenerative Energy Sources, Their Potentials and Utilization Possibilities in the FRG

Regenerative energy source		Theoretical potentials World	Theoretical potentials FRG[1]	Average power density for FRG	Secondary energy	Type of system
Solar radiation		1.55x10^9 TWh/a	250x10^3 TWh/a	With a maximum of 1,600-2,000 h/a [hours/year] of sunshine, average values of 100 W/m^2 [4]	Electric energy	Photovoltaic power generation
						Solar-thermal power generation
				Marked fluctuations; time of year, day/night, degree of cloudiness, orientation of the receiving surface, and so forth	Thermal energy	Flat collectors for warm water, possibly heating
					Chemical energy	Forced photolysis
WATER POWER (Inland waters)		44x10^3 TWh/a	110 TWh/a[3], of which more than 60% already being used	Variable, generally relatively high	Electric energy	Running-water power plants
					Electric energy	Stored-water power plants
WATER POWER (Sea)	Waves	8x10^6 TWh/a		14 kW/m of wave front (average North Sea wave)	Electric energy	For example, water turbine in pipe, Ø pipe 5 m, wave height 1 m = 50 kW
	Current			Slight	Electric energy	Water turbines
	Tides	26x10^3 TWh/a		Tidal amplitude of Ø 3 m too small along German North Sea coast	Electric energy	Storage pool with water turbines
	Ocean heat	3x10^3 TWh/a	Not utilizable	Small, at least 20 K temperature gradient necessary	Electric energy	Floating power plants with refrigerants
Wind energy		30x10^6 TWh/a	220 TWh/a	About 30 W/m^2 of rotor area subjected to wind flow	Electric energy	Wind-energy systems (rotors)
Environmental heat	Soil					
	Water					
	Waste heat				Thermal energy	Heat pumps
	Air					

Regenerative energy source	Theoretical potentials World	FRG[1]	Average power density for FRG	Secondary energy	Type of system
Geothermal energy	80×10^3 TWh/a	138 TWh/a	63 kW/km^2, technically utilizable only with geological abnormalities, since then power density is higher	Electric energy	Steam power plants
				Thermal energy	Warm water for heating purposes
Biomass	1.5×10^6 TWh/a		With soil utilization, about 1 kWh/m^{2}a	Electric and/or thermal energy	Energy-plantation processing--conventional power plant
Glacial ice		Not utilizable		Electric energy	

1) FRG - Federal Republic of Germany including West Berlin
2) Comparison with energy produced per year by 1,300-MW nuclear power-plant unit
3) Electricity converted into primary energy demand for thermal generation
4) Annual average values
5) Electrical power
6) Thermal power

Technical problems	Expenditure	Environmental questions	Prospects for applications and possible contributions from regenerative energy sources[3] for FRG in the year 2000	TWh/a	%
Poor efficiency of solar cells (4 to 16%)	100 to 1000 DM/W[4]	Area-intensive: 1,300 MW[5] needs about 13 km x 13 km[2]	Only for special applications (broadcasting stations, etc.). Studies: Satellite Solar Power Station	<<	
Use of mirror systems, efficiency small (max 10%)	About 1000 DM/m^2 very high	Area-intensive	Only for special applications (testing stage, pilot projects)	<<	
Discontinuous output, storage problems, pollution, durability	High, 100 to 500 DM/m^2	High area requirement	Increasingly used--especially for dwellings and swimming pools	33	9 (reservoirs)
So far, only laboratory tests	--	--	--	--	--
Geological difficulties with increasing expansion	High	Few problems	Often economically justifiable only in conjunction with expansion of waterways	85[3]	24
	High	Establishment of artificial lakes	River control		
Storage, power transfer, lifetime of the systems		Possible obstruction of shipping and fishing, large facilities can decrease water circulation	Applications for special purposes, for example light buoys, otherwise presumably slight	<<	
Large propellers; electricity transfer		With large facilities, restriction of currents, shipping!	Very slight	<<	
Tidal amplitude, construction of the storage pools	If 3 m of tidal amplitude were utilizable, an embankment dam along the German North Sea coast from Norderney past Helgoland and Sylt would meet about 8% of the present electricity demand in FRG		Very slight	<<	
With respect to output, very large facilities, power transfer	High	Possible climatic consequences (Gulf Stream)	Not utilizable	--	
Small power density, storage, durability	About 5,000 to 12,000 DM per kilowatt	Area-intensive: 1,300 MW require 2 x 40 km with wind wheels 185 m high	Partially utilizable	24	7
Improvement of efficiency of use or coefficient of work/year a	a = 3 to 3.5 a = 3 to 3.2 a = 2 to 4 a = 2 to 2.5	With large-scale use, possibly micro climatic effects Additional power demand	Assured use	210	60

Economical fields of application already exist

Technical problems	Expenditure	Environmental questions	Prospects for applications and possible contributions from regenerative energy sources[3] for FRG in the year 2000	TWh/a	%
Continual magmatic changes in the subsoil; often contamination of the steam or water; locating of the abnormalities; recovery; distribution	Given a theoretical utilization of the earth's heat at a depth between 4 and 6 km over the entire surface of the FRG, only about 10% of the present electricity demand in FRG could be met		No assured prospects	-	
			Slight	<	
High energy expenditure for harvesting and processing	About 22,000 km^2 for 1,300 MW[5] = 8% of the area of FRG	One-crop system, world food problems	Only for special cases, very slight	<<	
			Not utilizable	--	
				352	100%

Primary energy demand World 1979: 75 x 10^3 TWh/a
World 2000: 122 x 10^3 TWh/a

FRG 1980: 3,183 TWh/a
FRG 2000: 4,150 TWh/a — 8.5% based on 4,150 TWh/a

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FRG-BELGIUM COAL GASIFICATION EXPERIMENT BEGINS IN FALL

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 11 Sep 81, p 7

[Text] Frankfurt, 10 September. This autumn, below-ground coal gasification for the purpose of obtaining gas from an "intact" coal seam in Belgium will begin. The experiment is being conducted as a joint project between the FRG and Belgium within the context of an agreement signed in 1978. In its present, first phase, gas with a low caloric content is to be obtained; starting with the coming year, "richer" gas is to be obtained. This coal mining operation without a miner in the form of gas could considerably improve the energy situation of the coal-rich countries.

This kind of below-ground gasification has already been used in the Soviet Union for decades and it is currently being tested in the United States. The Soviet gas-supplying coal fields (the first one was placed in operation in Angren in the Donets basin) are a model for further developments in the rest of the world and they gasify coal through below-ground combustion. Air is injected into the borehole and it ignites the coal seam whereby most of the coal is gasified without burning on account of the throttled air supply. The gases are suctioned off and used by means of a second borehole which is about 20-30 m away. A connecting duct must first be made for the control of the gasification process between the two boreholes at the foot of the seam to be burned. This is done by means of "back-combustion" from the subsequent suction evacuation borehole.

The experimental fields in the United States, such as "Hanna," "Hoe Creek," and "Princetown," are also using this method. Gasification becomes somewhat more complicated in seams that are very steep, that extend to the earth's surface, and that in most cases contain much moisture or get moisture from adjacent rocks. The evaporation of this water requires a decisive share of the heat energy generated by coal gasification, that is to say, it causes heavy energy losses.

This water content also caused the failure of a project for coal gasification in Morocco during the early fifties. A coal seam was gasified there and it likewise was positioned in a very steep manner and contained much water. The gasification front was laid out only at a depth of 50 m. In the process, a gas with a combustion value of only 1,450 kJ per cubic meter was produced and, on the average, only 30 percent of the caloric energy of the gasified coal were obtained, partly because

of the moistness of the coal and its neighboring rock and partly because a portion of the gas obtained (gases and possibly also the injected air) was lost due to cracks and fissures in the bedrock.

This experiment at Djerada in Morocco was then abandoned very soon. But it provided interesting operating data which were used at the start of the planning for a Western European experiment on below-ground coal gasification in order to calculate the potential of such a "coal-seam gas field" under better operating conditions in theoretical terms. Accordingly, the same coal field, if it had been at a depth of 700 m, with "dry" coal and "sealed" against the surface, under identical operating conditions, would have yielded a gas with double the caloric content. If the air had been injected with higher pressure, the caloric content of the gas would have been three times higher. In the first case, the coal would have been used to the extent of 53 percent and in the second case to the extent of 70 percent.

These data and the other experiences became the guidelines for the West German-Belgian joint experiment on coal gasification adopted for the year 1978, an experiment which had been underway in Belgium in 1979 in the region around Thulin. At the edge of the Borinage coal basin there, we have a zone with coal seams which had never been mined before because they are subjected to very strong "orogenic disturbances"; this region is particularly suitable for coal gasification below ground above all in the experimental stage because the seams and the neighboring rock have not been "disturbed" as a result of mining and therefore are particularly well sealed agains the surface.

In the GLUECKAUF-FORSCHUNGSHEFTE the leader of the German-Belgian "Project Group for Experiments on 'In-Situ Gasification' of Coal," Pierre Ledent, Liege, recently reported on the problems and the development status of the project. In his report, Ledent points out that "below-ground working of our deep deposits is an outdated method of energy procurement which is no longer in keeping with the living standard of our people." That was not recognized about 30 years ago when the big economic expansion began in Western Europe and the technology of obtaining coal energy "without miners" through below-ground gasification, which was developing at that time, was not further advanced. Now that Europe has become clearly energy-dependent as a result of the oil crisis--a condition which cannot be adequately terminated by using coal because of the tremendous wage costs--underground gasification could be an answer to Europe's problems. By the end of this century it could experience an upswing similar to the one which coal mining achieved at the start of the last century.

The beginning toward this new technology in this experimental undertaking between two countries of course is still being made by using the technology available at the start of the fifties, something which was developed above all in the Soviet Union; the idea is to start underground gasification by burning the coal seams off from boreholes, specifically after building a connecting duct through "backfire burning" between two boreholes. There is also the intention first of all to start with small "gas mining fields"--that is to say, with boreholes at a small interval of about 35 m. The decisive difference between the West German-Belgian experiments and past experiments aimed at achievement in underground gasification consists in the fact that very deep seams are to be gasified in Thulin. They are located between 800 and 900 m. Of course, this kind of gasification at great depths also calls for a much greater expenditure for the drilling of boreholes which furthermore must be dug very accurately "aimed" into the depth in order to

achieve the right intervals at the foot of the borehole and thus to get the correct experimental results.

This experiment in the meantime has advanced to the point where the planned four deep drilling operations are ready so that the coal for backfire combustion (that is to say, the gas pipeline duct at the bottom of the seam) can be set on fire; this is supposed to be done very shortly, presumably this autumn. After the completion of the connecting ducts, the engineers will first of all start with gasification on a larger scale, the idea being to work with air injection. When the coal seams are that far down and when the coal is dry, it is necessary to add some water vapor to the air in order, during gasification through partial combustion, to get the desired product, a "synthesis gas" consisting of carbon monoxide and hydrogen.

It is expected that the seam, "thus stripped of its coal," will gradually be filled as the "covering rock" sinks down from above--something which creates the possibility of orogenic damage. But the rocks above the seam must first sink down so that the seam to be gasified will remain constantly sealed. The superposed rock formation may sink only "plastically" and not in a "fractured" fashion if density is to be guaranteed. Besides, this energy procurement method is likewise tainted by an environmental problem: One cannot rule out the possibility that small quantities of carbon monoxide might rise to the earth's surface from the seam to be gasified. Thus it is necessary to conduct experiments with seams which are located under an area that is not inhabited.

The current experiments of course are only supposed to be a first phase in this joint experiment. It is hoped that it will be possible to go on to the next phase already next year, when the area of the gas mining fields is to be expanded by using boreholes with far greater intervals (50-70 m) for gasification so as to improve the exploitation of the expensive drilling operations considerably. Besides, the idea is then to work with oxygen plus steam as gasification agent, instead of working with air plus steam, in order to avoid burdening the gasification method with the 80 percent nitrogen which are added to the air. This nitrogen is dragged along during the entire reaction; it must be forced through the pores of the hard coal under pressure and it drags unused caloric energy away.

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OFFICIAL DANISH TEST SITE FOR COMMERCIAL WIND POWER PLANTS

Stockholm NY TEKNIK in Swedish 30 Jul 81 p 4

[Article by Karl G. Jonsson]

[Text] There is presently a rush for small wind power plants in Denmark. Several manufacturers have orders for over 100 plants. New designs are coming out constantly.

The Riso research station holds a key position in Denmark's wind power program. The station is the official test site for wind mills.

The Riso test facility on the Roskilde Fjord has everything from nuclear power technology to agricultural research. Two years ago the Testing Station for Small Wind Mills was opened.

In the beginning an engineer and a mechanic were employed. Now Per Lundsager has 10 workers under him and before the end of the year that figure may almost double.

Testing and Advice

The testing station is active in four areas: Free advice is given to manufacturers, purchasers, and authorities. The manufacturers must construct the wind power plant themselves for testing on the "test track" at Riso. Further, systems evaluations are made for the type approval required for state funds. Finally, research and development are carried out--a task that so far has suffered because of the assault from outside.

Because of the enthusiasm for wind power in Denmark engineers at Riso have seen all imaginable--and some unimaginable--models at the test site, from the small Darrieus wind mill from the technical university to the so-called Ulril Poulsen mill which attempts to avoi using a high and expensive support by mounting the rotor on a long axle slanting up into the wind.

"There are still some manufacturers who do not understand that you get nothing free," Per Lundsager said. "What they gain in simplicity, they lose in efficiency."

So far over 40 applications for type approval have come in and 34 models have been approved.

A "wind atlas" has been developed on Riso which calculates the annual production of electric power for a given model at a given location within a 5 to 10 percent margin of error.

Agricultural Buyers

Most investors in wind power today are farmers or gardners.

The Energy Ministry contributes 20,000 kronor toward the purchase of each wind power plant with type approval from Riso.

"The calculated lifetime is 25 years," Per Lundsager said, "but at present we are only guessing."

"Our analyses indicate that regardless of what one purchases, energy price rises are the deciding factor. Most often the windmills are profitable after just a few years and experimental windmills built 4 or 5 years ago are already yielding large profits.

Test site for wind power plants at the Riso research station in Denmark. All imaginable--and some unimaginable--models may be seen here.

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ENERGY

BRIEFS

EC SUBSIDIZES COAL RESEARCH--The EC has made available a total of DM 40 million for 36 programs designed to improve mining technology and to promote the development of coal refinement. On the average, 60 percent of the project costs will thus be taken care of. The FRG gets 12 projects with an allocation of DM 15.6 million. Among other things, the idea is to promote the development of new methods for coal liquefaction; this is being pursued by "Mining Research, Incorporated" in Essen-Kray in cooperation with several college institutes. The EC Commission participates with DM 2.3 million in the costs which total DM 3.8 million. Results from the program, which has been underway since the beginning of this year, are to be available at the end of 1982. [Text] [Duesseldorf EUROPA CHEMIE in German No 22, 1981, p 369] 5058

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STEEL INDUSTRY GETS MAJOR FACELIFT WITH GOVERNMENT FUNDS

Stockholm NY TEKNIK in Swedish 30 Jul 81 pp 8-9

[Article by Harald Gatu]

[Text] Domnarvet is changing. With investments of 1.5 billion kronor, SSAB (State Steel Corp.) will make Domnarvet a leading producer of thin sheet metal. With new Japanese technology, the sheet will be used extensively in the automobile industry, which imports most of its thin sheet at present.

The change has another side, however, and another price: Domnarvet is losing about 2,000 jobs and the unemployment line in Dorlange will become longer and longer.

The new Domnarvet will be complete early next year.

During the vacation weeks Domnarvet's steel mill is normally ghostly silent. This summer the picture was different: about 600 contractors, along with Italian, Japanese, and West German experts, were rushing to finish the expansion of Domnarvet's band and thin sheet production lines.

Almost half of the just over 3 billion kronor invested by the state in SSAB has gone to the Band 82 project which will make Domnarvet one of the leading producers of thin sheet in Europe.

At the same time, Domnarvet has lost over 1,000 jobs and almost as many, 800, will be lost in December of next year. Domnarvet has provided jobs for as many as 6,200 workers. The goal is to reduce the number of employees to 4,400.

"We can possibly reduce this figure even more," Domnarvet director Sten Forslund said. That would be most sensible from the standpoint of business economics.

Borlange has paid a high price for the structural change in the commercial steel industry. Unemployment will soon skyrocket. For over 100 years young poople have more or less always found work "down at the mill." Now the gates are closed, however.

During the past 5 years the heavy plate, medium section rolling mill, the blooming mill, four smelting works, two Kaldo furnaces, and the sinter plant were shut down. Last fall the last smelting works was closed.

A mill with no smelting works is like a body with no heart, the people in the village said when the smelting works, the scintillating center of the mill, was

put out. Suddenly there was no one asking for several hundred workers' unique skills that had been handed down from one generation of foundry workers to the next.

"Demand continued metal production: could be seen in meter-high red letters painted on the overpass near the northern gate as we rushed past in Sten Forslund's car. Forslund was previously head of ore metallurgy along with its smelting works. Now he is head of the entire plant.

The guards in the booth recognize him and wave as we pass through the remote-controlled gates. We continue quickly past buildings closed for vacation and drive toward the "new" Domnarvet.

Work is in full swing, however, at the wide strip mill. People in different colored overalls from different contracting companies are gathered around Stig Oskar Persson, project leader for expanding the wide strip mill. A thorough modernization is underway and the capacity will be almost doubled to 1.2 million tons per year.

The first thing we see is the large new transforming station with new driving motors that will provide twice as much power as before.

About half of the ten or so Italians who are occupied with Band 82 are in the furnace plant. They are experts involved in assembling the new reheating furnace. Here the steel ingots from smelting works in Lulea and Oxelosund, as well as from Domnarvet's own-scrap-based electric furnace works, are heated before it is time for the ingots to be rolled.

The new reheating furnace will have twice the capacity of the old furnace: 300 tons will be heated every hour. This energy guzzler, which is oil-fired, will have advanced equipment for energy recycling. The principle is that the air of combustion is heated by the exhaust gases.

When an ingot has passed through the furnace it proceeds to the universal mill where its thickness is reduced by rolling before it enters the wide strip mill's so-called finishing mill where its thickness is further reduced.

Before the sheet enters the finishing mill, however, it passes through a coil box, which is the great innovation in this production line. The purpose of the coil box is to eliminate the problem of trains that are too short. The distance between the wide strip mill's breakdown rollers and finishing rollers is only 50 meters and this prevents rolling of longer ingots.

With a coil box the distance is increased, almost doubled. This means that ingots almost twice as long can be rolled by rolling up the sheet between the breakdown rollers and the finishing rollers. "Coil" is the English word for to roll up.

"The results are higher productivity, energy conservation, and more even quality," Sten Forslund said.

Higher quality is achieved primarily because an even temperature can be maintained. The coil box was assembled outside the rolling mill and when the wide band mill was closed for vacation it was simply installed on the production line. In addition, a new shearing section was installed, also with the help of the Italians.

The entire wide strip mill, from the point where ingots are inserted into the furnace to the end where the rolled sheet is reeled into a roll, is provided with a computerized process control system. The process is followed by way of numerical values on TV screens in the control room.

The rolls of sheet metal are taken by fork lifts to the cold rolling mill, which is now located inside the enormous blue and white building which now houses Domnarvet. The mill will be completely finished early next year.

The new pickling section stands finished beside a large and desolate warehouse space where the rolls from the wide strip mill will be stored. Here the oxide coating is removed by a series of baths in hydrochloric acid and water.

This August the next stage in the modernization of the cold rolling mill should be complete. The rolling mill, which presently has four pairs of rollers, will add a fifth pair. In the four older pairs of rollers the two working rollers (which are closest to the sheet) are each supported by a supporting roll.

The problem with these rollers is that they do not make the sheet sufficiently even. The rolling pressure has been least in the middle, so that the working rollers have been thicker in the middle to make the sheet even. Nevertheless, the evenness has not been satisfactory.

An extremely thin and even sheet can be produced with the new fifth roller. Here the two working rollers are supported not by two but by four supporting rollers. Two of these supporting rollers possess lateral mobility and thus they can even out the rolling pressure over the entire sheet.

The capacity will increase to 700,000 tons per year. This is 3.5 times more than what the four old rollers produced.

The fifth roller is being installed with the help of half of the 20 West German experts now working at Domnarvet. The rest of the Germans are working with the 10 Japanese on the next major project at the cold rolling mill: the continuous annealing line.

Here the sheet is annealed, trim rolled, and cut into rolls. Previously this process took 10 days. With new Japanese technology, however, it will take only 10 minutes. The time savings occur because the process is uninterrupted. It is now possible to eliminate the storing and cooling of the sheets between the various processes. Previously the sheet was heated in large, so-called bell furnaces and then cooled for 3 days before the final trim rolling. After that one was forced to wait again before the sheet could be cut and finished.

A new process has also been included before annealing. It is an electrolytic cleaning that further increases the quality of the sheet. Domnarvet will be the first to use this process in Europe.

After the electrolytic cleaning the sheet passes through the annealing zone which is fired with LP-gas. Annealing makes the sheet soft and ductile. Before annealing the sheet can be stretched only by 2 percent before breaking, while after annealing

it can be stretched by 35 to 40 percent. After annealing the sheet is cooled rapidly in water after which it passes through a pickling bath which removes the oxides that were formed in the water bath. After that the sheet is heated again to further increase its strength.

After the drum roller, where the final rolling occurs, it is at last time to cut the sheet into rolls.

"The result is a very clean sheet with good pressing qualities," Sten Forslund said. "We can go from 0.60 to 0.35 mm thickness without losing strength in the sheet.

It is this aspect that will attract the interest of the automobile industry; a strong, lightweight sheet that is ductile and easy to paint. "Presently we deliver only 20,000 tons of thin sheet annually to the Swedish automobile industry, but we hope that this figure will increase many times over," Forslund continued. After all, 60 percent of the thin sheet is now imported.

The Band 82 project also includes expansion of the coating section, a modernization of the coating plant where the older of the two hot-dip galvanizing lines has been converted to a so-called aluzinc line. Here the sheet is coated with a surface layer of aluminum and zinc. This line began operation in June.

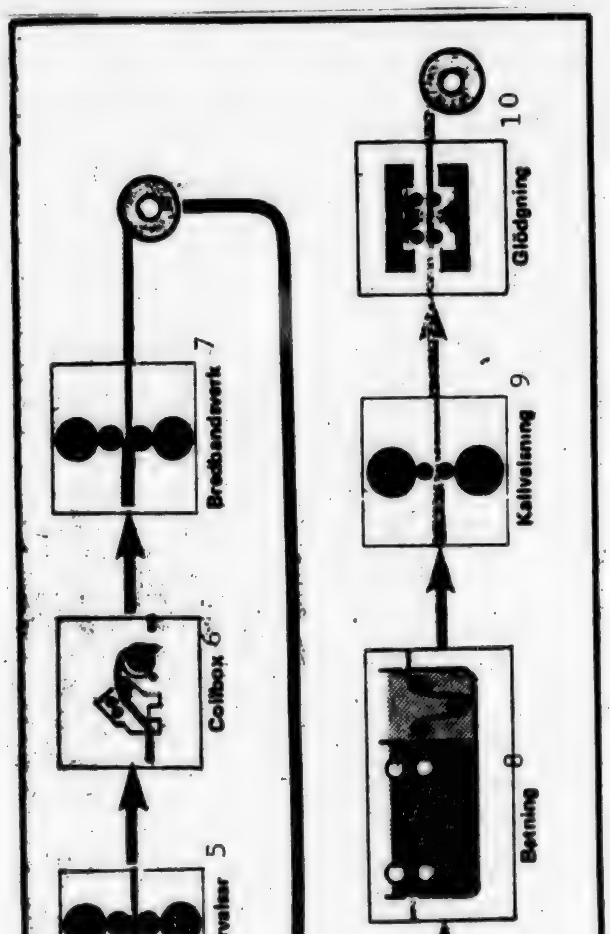
It is estimated that in January of next year the Band 82 project will be complete. At that time the final stage, the continuous annealing line, will be complete.

"At that time we will show what we can do," Sten Forslund said, opening the door to his Volvo. Volvo will be one of Domnarvet's most important customers in the future.

Path of steel in the new Domnarvet. From ingot to finished sheet.

Key to figure:

1. Electric furnace
2. Continuous casting
3. Ingots from Lulea Oxelosund
4. Universal mill
5. Breakdown roller
6. Coil box
7. Wide strip mill
8. Pickling
9. Cold rolling
10. Annealing



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SCIENCE POLICY

NATIONAL CONFERENCE ON RESEARCH, TECHNOLOGY LAUNCHED

Paris AFP SCIENCES in French 10 Sep 81 pp 1-5

[Excerpts] Paris--National conference on research and technology--Mr Jean Pierre Chevenement, minister of research, opened on the 8th of September the national conference on research and technology, " an initiative without precedent in the world," according to the minister.

This conference is to conclude with national science days, which will be observed from 13 to 16 January 1982 at the Palace of Congresses in Paris.

During these 4 intervening months, the 23-member national organization committee, chaired by Mr Francois Gros, director of the Pasteur Institute, will canvas the scientific community through research groups, learned societies, unions, businesses, etc, for their views on 6 major themes:

1) Scientific research and technology in relation to society: An important consideration will be the problem of the researcher's responsibility.

2) Research and technology: a choice and a strategy for the future.

3) The development of research and technology: a driving force for emerging from the crisis. It will involve focusing our thoughts, on the national as well as the international level, by examining the socio-economic impacts of scientific and technical progress, the problems of industrial research and the expansion of the public sector, research and technology in the Third World, etc.

4) Research and technology: men and organizations. This theme should encompass questions like the enhancement of the researcher's status and the vitalization of institutions, education for research and by research, employment in science, research in business, the transfer of knowledge, the stimuli and restraints to innovation, the regional dimension of research, etc.

5) Science and decisionmaking: beyond the scientific community, it seems absolutely necessary that laymen be able to articulate their views about the great problems arising out of scientific and technical progress; hence, the importance of disseminating scientific information and of public debates on the implications of science.

6) Implementing measures: the general idea of this last theme would be, somehow, to establish a great national goal in the context of a program law.

During the national days, preparatory acts will be presented to define "democratically" the broad features of the 4-year research orientation law to be voted on in the spring of 1982.

The industrial sector, which represents 58 percent of the research effort, will be associated with this undertaking. Public enterprise will take the lead because, according to the minister, "it's impossible to conceive of a policy of nationalization without national enterprises playing a predominant role." But the private sector is also included: plans call for fiscal incentives and funds resulting in the improvement of the technical centers, explained the minister.

The research effort to be accomplished is really very sizeable. In 4 years, the government wishes to increase research funds from 50 to 80 billion francs in order to reach, as has Japan or the FRG, 2.5 percent of the gross domestic product in 1985.

"We want this debate to be perfectly open," declared the minister, "particularly in order to counter the anti-science movement which has been showing signs of renewed vigor lately."

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SCIENCE POLICY

BRIEFS

SIX RESEARCH AREAS FOR STUDY--Paris--Study groups in six broad research areas--Six broad areas of French scientific research are going to be studied by six groups of prominent figures from the world of research and industry. An announcement on this subject was made in the August 9th Council of Ministers by Mr Jean-Pierre Chevenement, Minister of Research and Technology. These six areas are critical, according to the Minister, but they are not intended to detract from the other research sectors. They are biotechnology, the electronics industry, robotics and automation, research on employment ahd the improvement of working conditions, scientific and technical cooperation with developing countries, and new energy sources. The study groups created by the Minister of Research, in conjunction with other ministries, will mainly have to make an inventory of what exists in each area and propose a coherent policy for the coordination of teams and the training of people. These projects will be submitted to the Parliament at the time of the budget vote in the spring of 1982. Gradually the groups, which have no funds of their own, will be converted to national committees of an interministerial nature and, as of next January, will be able to participate in the national conference on research and technology. [Text] [Paris AFP SCIENCES in French 10 Sep 81 p 6] 9816

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VFW STUDIES CAST-ALUMINUM ALLOYS FOR USE IN AIRCRAFT

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 8 Sep 81 p 5

[Text] Considerable cost savings and weight reduction can be achieved in the future with components of cast-aluminum alloys, not least of all because more individual parts can be manufactured from cast alloys than were previously considered possible. The Bremen aircraft construction firm VFW [Consolidated Aircraft Works] reached this conclusion on the basis of tests which have been running since 1978. In the company's view, however, a condition for the use of cast parts is that the metallurgical and design characteristics of the casting method are fully utilized. Analytical tests on components which were representative of individual subgroups had shown cost savings of 25 to 60 percent with simultaneous partial weight reduction.

It was necessary to establish the stress behavior of these compounds and compare it with riveted samples of forged-aluminum alloy to solve the problem of mechanically joining components of cast-aluminum alloys. The technical manufacturing tests were concluded with extremely good results and, in the view of VFW, confirm that the building-in of bonding elements (rivets) into cast-aluminum alloy components is possible in every case. As part of the test program, sample bars of the alloy A 357 are made from cast-aluminum sheets, joined with solid, blind and shoulder rivets and subsequently subjected to static and dynamic loads. Evaluation of the statistical tests showed that when solid rivets are used the stress behavior of the compound "cast-aluminum alloy A 357/bonding elements" is equal to forged alloy.

Comparative fatigue tests were conducted with various sample shapes, which were riveted with various types of bonding elements. Since the same tests were carried out at VFW on samples made of forged-aluminum alloys, it was possible to compare the two materials with regard to their fatigue-strength behavior. The result was: the fatigue behavior of the cast-aluminum alloy A 357 is not as good as with forged-aluminum alloys at higher loads. At lower load levels, according to VFW, the fatigue behavior of the riveted joint made from the cast-aluminum alloy was equal; at higher load reversals (longer loading) it was actually better than with forged-aluminum alloys.

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